REVIEW

A Constructivist-based Proposal for Teaching Practices During Lock-down

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Abstract

The COVID-19 outbreaks have caused universities all across the globe to close their campuses and forced them to initiate online teaching. This article reviews the pedagogical foundations for developing effective distance education practices, starting from the assumption that promoting autonomous thinking is an essential element to guarantee full citizenship in a democracy and for moral decision making in situations of rapid change, which has become a pressing need in the current context. In addition, the main obstacles related to this new context are identified, and solutions are proposed according to the existing bibliography in learning sciences.

KEYWORDS: constructivism, e-learning, online teaching, social constructivism theory, cognitive learning theory, transformative learning theory

Introduction

The COVID-19 pandemic has caused serious alterations in the world's education system, and due to the viral characteristics, it is very likely that this situation will repeat in the near future. This reality has forced a crash course for online learning plans and technology for students and faculty members.

Universities across the globe are struggling to set up the technical systems needed to move courses, exams, research and other activities online. In the words of Carol McQuiggan, former Director of the Faculty Center for Teaching and Instructional Technology at Penn State Harrisburg, 'what worked for them in the past in their traditional classroom may no longer be helpful or reliable in the distance education context' [1].

Qualitative research into online learning suggests that students experience greater dissatisfaction, interpersonal isolation, feelings of unclear direction and uncertainty, and a lack of engagement in this environment [2] [3] [4] [5]. Despite not being associated with a single cause, research indicates that a crucial mistake is to perceive technology only as a channel for transferring content, used as a substitute for other tools, ignoring the growing knowledge about pedagogical practices in online education [6] [7].

The vast empirical evidence highlights that to advance our understanding of online learning in higher education, a coherent theoretical framework must guide the research and practice of web-based online teaching and learning. This paper summarizes the pedagogical foundations necessary to develop quality distance education practices, according to the existing bibliography. In addition, it seeks to help trainers

organize their computational biology lessons by establishing the theoretical basis for our recommendations on online teaching described in Serrano-Solano et al. [8].

Theoretical Framework

As Anderson, Rourke, Garrison, and Archer posited, online teaching is an extremely complex and challenging undertaking [9]. Due to its nature, it requires to move beyond traditional models into new practices more focused on the collective construction of knowledge rather than simply on the delivery of content [10].
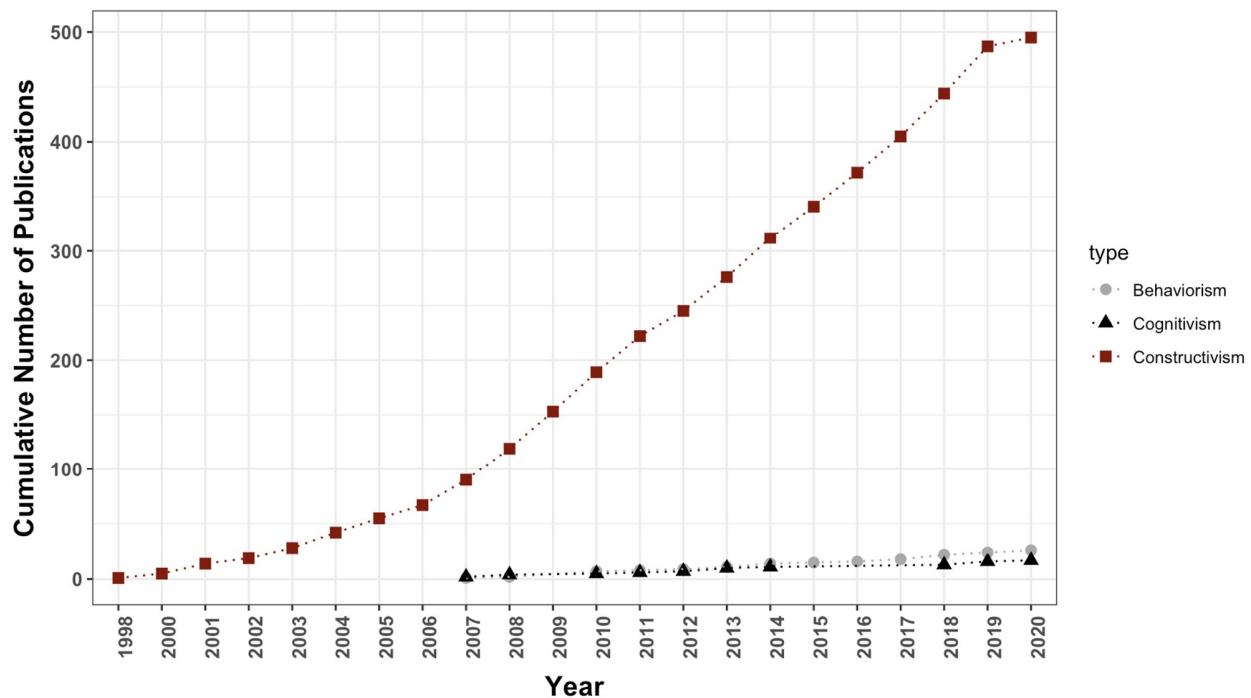
Figure 1. Bibliometric analysis results of publications on online learning in the Scopus database.

It can be inferred that, according to the growth rate of scientific publications based on Scopus database bibliometrics (Fig. 1), the constructivist approach is the most popular in online learning research. In order to optimize the learning process, we propose constructivism as a starting point and therefore, specific elements from its three auxiliary theories should be incorporated: social learning theory, cognitive learning theory and transformational learning theory (Fig. 2).
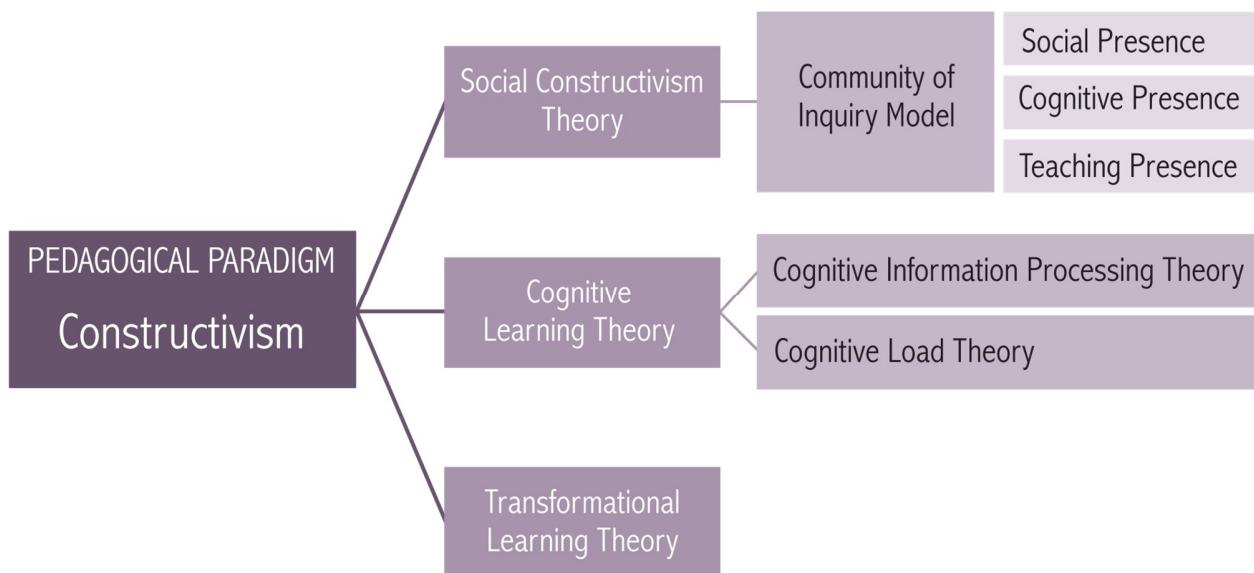
Figure 2. Proposed theoretical framework.

Constructivism as Pedagogical Paradigm

Constructivism roots have their origin in the work of the Swiss psychologist Jean Piaget. Its core idea is that knowledge acquisition is a dynamic process which must be led by the learner through experience, discussion and reflection [11] [12].

According to this paradigm, students, far from being passive recipients of information, must act as the active protagonist of the learning process, for which it is recommended to promote practices that are usually absent in traditional education contexts, such as encouraging themselves in reshaping new information through active consideration [13] [14].

The flexibility offered by online learning is one of the key aspects to consider the constructivist theory as especially suitable for this context since it assumes that students learn better when they control the pace of learning [15].

Another important aspect of this pedagogical approach is the value it attaches to embed learning in realistic contexts, giving a special value to learning experiences which involve real-life problems [16] [17].

Social Constructivism Theory

An important component of learning is the social interaction between participants. Online learning requires adjustments by instructors as well as students for successful interactions to occur.

According to the social constructivism theory, the knowledge construction process takes place more efficiently in a social context, where ideas can be shared and challenged [18] [19]. This is in harmony with research by Palloff and Pratt, which points out that establishing a learning community is essential for implementing online learning practices successfully [20].

The community of inquiry model [21] describes the online educational experience in a learning community as arising from the interaction of three elements: teaching presence, cognitive presence and social presence.

As stated by Garrison et al. teaching presence involves design and administration, discourse facilitation, and direct instruction [21]. Design and administration involve precision and transparency in planning instruction, discourse facilitation requires effort on the part of the instructor to maintain active learning, while direct instruction focuses on intellectual and scholarly leadership [9].

Cognitive presence can be operationally defined as a cyclical process consisting of four steps: problem identification, collective exploration through critical reflection and discourse, knowledge construction from the previously confronted ideas, and integration of the newly gained knowledge through its practical implementation [22]. Teaching presence is considered essential in order to prevent the interruption of the processes during the initial phase, thus allowing more advanced stages of critical thinking and cognitive development [23].

Social presence - defined as the competence to transmit the feeling of closer social contacts in a certain communicative context - is considered an essential factor for establishing functional learning communities [24] [25]. According to this construct, the potential of certain communication technology to transmit social presence is directly proportional to its ability to transmit non-verbal information [26]. Research indicates that adequate social presence is intimately related to both students' perception of the learning process and their engagement [27] [28].

It is considered that despite cognitive and social presences being indispensable factors for achieving higher levels of learning, the success of educational practices depends on the instructor capacity to properly structure the interactions in the community through an adequate design of the learning process [29].

Cognitive Learning Theory

Diverse authors agree that, in order to implement adequate online teaching practices, it is necessary to take into account the characteristics of mental processes [30] [6].

Cognitive learning theory aims to describe the links between cognitive structures -defined as the mental representations of objects or ideas- and the learning process [31][32]. Two important theories derive from this one: information processing theory and cognitive load theory.

The information processing theory describes learning as the result of sequential processing of information, which involve three types of memory: immediate memory, working memory and long term memory [33]. According to this theory, adequate learning resources require to assume two key elements: firstly, the fact that working memory is limited; and secondly, that the interaction between working and long term memory plays an important role in the construction and transferability of knowledge [6] [13] [34].

On the other hand, cognitive load theory seeks specifically to address the efficiency with which information is processed. It states that the verbal and visual information is processed by independent cognitive structures, both of them with a limited capacity [35] [36] [37] [38] [39]. An interesting concept derived from this theory is the cognitive overload, which refers to those situations in which the information flow exceeds the learner's processing capacity, resulting in an inhibition of the learning process [40] [41].

Transformative Learning Theory

Transformative learning theory [42] aims to define the mechanisms involved in the development of critical thinking during the learning process. According to Richard Paul, 'the traits of critical thinkers include independent thinking, intellectual empathy, intellectual humility, courage, integrity, perseverance, intellectual curiosity, faith in reason, intellectual civility, and intellectual responsibility' [43].

Transformative learning occurs when the learning process induces a shift in the student's frame of reference [42] [44], e.g. the role assigned to science by the students, their self-concept and role in society, etc. Although this goal can be achieved in multiple ways, a successful strategy is to stimulate reflection on uncritically accepted assumptions, such as those derived from cultural assimilation, through the exchange of points of view within a learning community [42] [45] [46]. It is the educator responsibility to cultivate students' skills related to autonomous thinking by designing activities for that purpose [43].

Major online-learning challenges

As claimed by Goolam Mohamedbhai, member of the governing council of the United Nations University, 'it is a fallacy to believe that online learning can be effective by merely posting a lecturer's notes online or having a video recording of the lecture' [47]. In addition, the performance of the learning community can be affected if the majority of the members do not manage to adapt to the online context [48]. Therefore, it is important to carefully analyze the e-learning' problematic dimensions.

Teaching effectiveness in technology-mediated learning

Technological tools, due to their design, do not act just as neutral means for transmitting information, but they also transmit values and habits of thought [49] [50]. Thus, for example, when teaching is dominated by one-way media, hierarchical relationships are promoted, which entails an attack on critical thinking [51].

When considering video-records as teaching tools, it is important to incorporate those auxiliary technologies which could increase their pedagogical potential, such as including short-quizzes [17]. Those strategies can result in improved teaching and social presence, which in turn are linked to an increase in the students' engagement.

Communication is crucial for assessment but a critical point to take into account when selecting the tools is that synchronous and asynchronous ones should be used for different educational purposes in online courses. Research indicates that synchronous discussions are more useful for fostering social presence, while asynchronous communication for developing higher levels of thinking [52] [29].

Teacher's role in online teaching

Web-based environments require deep cultural shifts, such as sharing control of the learning process, which can result in a loss of teacher's professional identity [53] [54] [55] [56]. In addition, the teacher's role as a learning facilitator is usually linked to higher levels of stress [57].

Results indicate that, in a video-conferencing environment, an instructor's positive attitude towards technology, interactive teaching style, and control over the technology, are related to perceived learning effectiveness, with teaching style showing the most important influence on student involvement and participation [58]. Teachers who are skilled at community building are considered particularly valuable [59].

On the other hand, qualitative data suggest that students place a high priority on the instructor's ability to establish and maintain an engaging and constructive discussion environment [60]. In addition, carefully planned interactive activities lead both to greater learning and enhanced motivation [61] [62].

Student engagement in online environments

Online learning puts special demands on students to stay motivated and focused [63] [64]. For this reason, instructors must consciously supply this need with a combination of motivational techniques.

Firstly, as in classroom teaching, intrinsic motivation is key. To boost it, instructors need to understand each student's short and long-term personal learning goals and then design activities that resonate with them, if possible by using real-life problems [63] [65].

Another motivational technique which has been suggested as extremely useful consists of fostering learner' self-directed learning pace [65]. To this end, it is essential to establish a cooperative environment in which students were able to self-organize the learning process, starting from certain guidelines provided by the instructor, who should act as a facilitator rather than as an authority on the subject [42] [67] [68] [69].

Finally, a third motivational technique considered useful for improving teaching effectiveness and student engagement is the design of learner-centred syllabus, characterized by shared decision-making and structured and clear objectives [70] [71].

Creating an effective learning community

Establishing a functional learning community has been proved to be a key factor for overcoming some of the major drawbacks linked to distance education, such as the student's feeling of isolation and their lack of motivation and interaction [72] [73] [74].

It's the instructor's responsibility to stimulate the creation and maintenance of a structured network of reciprocal interactions between students that enables the collective construction of knowledge efficiently [75]. Research results indicate that students who are appropriately integrated into learning communities obtain higher grades [76]. In addition, quantitative results suggest a relationship between interaction levels and group size, and that group size is a critical factor to the effectiveness of learning [77] [78].

Conclusion

The COVID-19 pandemic is probably going to entail a turning point for the global educational system. The profound cultural changes imposed by the general situation of uncertainty are going to force the previous teaching practices to adapt to this new context.

We consider that, in order to collectively face the challenges associated with the current situation, it is necessary to establish a conceptual framework shared by the whole educational system and capable of offering the necessary tools to uphold the quality of the educational practices.

Our proposal relies on a fundamental pillar: the constructivist paradigm as the philosophy of learning, that is, to consider the promotion of autonomous thinking as an essential element to guarantee full citizenship in a democracy and for moral decision making in situations of rapid change. From this starting point, we consider that three main theories must be deployed: the social constructivism theory, the cognitive learning theory and the transformative learning theory.

Assuming this theoretical foundation, it is possible to overcome the main caveats of distance education - such as the student's feeling of isolation or the teacher's ability to maintain their engagement in online environments - by paying special attention to the roles of technology, teaching practices, learning communities, motivation, and the way these elements interact with each other.

TOP TIPS FOR INSTRUCTORS

● Make the learning process active and dynamic: let students experience rather than be passive learners by boosting discussion and reflection.
● Keep the motivation up: use real-life problems, understand each student's short and long-term personal learning goals.
● Be clear: give direct instructions in a precise and transparent way.
● Be flexible: let students control the pace of learning starting from certain guidelines, allow them to self-organize the learning process.
● Avoid hierarchical media: bidirectional communication promotes critical thinking.
● Use synchronous channels to foster social presence.
● Use asynchronous channels for higher levels of thinking.
● Build a community: be close, create a cooperative environment that encourages constructive discussion, share and challenge ideas to promote social interaction.
● Read the paper by Serrano-Solano et al. for technical advice on how to implement our recommendations easily.

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